

REPLACED SHEETS SG

☒ Description : paged to paged
☒ Claim(s) : paged to paged
☒ Drawing(s) : paged to paged
☒ Abstract : paged to paged
 DATE OF RECEIPT

TITLE OF THE INVENTION

LIGHT SOURCE DEVICE FOR AN IMAGE PROCESSOR

BACKGROUND OF THE INVENTION

The present invention relates to a light source
 5 device for an image processor which converts a picture
 image detected by an industrial television (ITV) into a
 binary numeral for further processing, and more
 particularly to a light source device of an image
 processor adapted to detect a solder leveler formed on a
 10 print circuit board.

The image processor which converts a picture image
 signal picked up by the ITV into a two-value data
 comprising a high level signal and a low level signal (1
 and 0) is now used in various technical fields. In an
 15 automatic mounting system of electronic devices, the
 image processor is used for detecting the mounting
 positions of the devices and positions of standard marks
 on a print circuit board.

Referring to Fig. 1, showing an example of a
 20 conventional image processor, an ITV camera 2 is mounted
 on a robot 1 at an appropriate vertical position
 dependent on a focal length of the camera. A light
 source device 11 is mounted on the ITV camera 2 around a
 lens barrel 4 thereof. The light source device 11 has a
 25 light source such as a cold-cathode tube and/or LEDs which
 emits light, and a diffusing plate for transmitting and
 diffusing the light. In order that diffused light

This Sheet Has Been Replaced



transmitted through the diffusing plate may have a sufficient quantity of light, a light source capable of emitting a relatively large quantity of light is selected.

5 The diffused light from the light source device 11 is projected onto a standard mark 10 formed on a print circuit board 3. However, only the light within a range indicated by dot-dash lines 11a between the light source device 11 and the standard mark 10 in Fig. 1 is applied
10 to the standard mark 10. The direction of light beam to be projected on the mark 10 is the direction included in the range between the lines 11a.

 Since the standard mark 10 is made of a conductive material such as a piece of copper foil, the surface
15 thereof is flat. Therefore, in the case where the position of the mark 10 is detected, a comparatively sufficient quantity of light is reflected on the flat surface, although the light in the only small range defined by the lines 11a is projected on the mark.
20 Consequently, an appropriate picture image can be obtained by the ITV camera. Hence no serious trouble occurs.

 The image processor is also used for detecting the position of a conductive member coated with solder, that
25 is, a solder leveler. The thickness of the solder coated on the conductive member is often irregular and hence the surface of the solder leveler is uneven. Namely, as shown in Fig. 4, the surface of a solder



leveler 12 formed on the standard mark 10 is uneven in most cases. Moreover, due to the surface tension of the molten solder, the surface of the leveler is smooth. Therefore, diffused reflection on the surface occurs very little. Consequently, the directions of the reflected light is determined by the incident angle of each light beam. Hence, depending on the inclination of the surface of the solder leveler, or the existence of pinholes, the light reflected on the surface, for example, at a point B shown in Fig. 2 is hardly detected by the ITV camera 2. As a result, the detected image data for the solder leveler 12 recognized by the image processor fails to show the portion corresponding to the point B.

More particularly, as described above, the light applied to the solder leveler 12 from the conventional light source device 11 is in the range between the lines 11a in Fig. 1. Showing light as being applied to a point A in Fig. 4, the light within a hatched area defined by lines 11b is projected on the point A. An incident light A_i reflected on the point A becomes a reflected light A_o which is directed toward the ITV camera 2. If the inclination of the solder surface becomes larger than that of the point A, the light A_i does not reflect to the ITV camera. In order to reflect to the ITV camera on such a large inclination surface, the light A_i must be applied at a larger incident angle. In other words, a more inclined direction than the



illustrated angle of the light A_i can be picked up by the camera. However, since the light having a maximum incident angle is the incident light A_i in the conventional light source device 11, none of the beams
5 reflected on such a steep surface are fed to the ITV camera 2, so that the image processor forms an incomplete image data having gaps.

As described above, if the inclination of the surface of the solder leveler is large or pinholes are
10 formed on the surface, the quantity of light fed to the ITV camera decreases. Hence the images are darkened, thereby further causing the gaps to be formed when converted into a two-value data.

When the image processor recognizes such an
15 incomplete image, the detected contour or the center of the image inevitably differs from the actual contour or the correct center of the object, thereby causing error in the measurements. In order to solve such a problem, there has been proposed an image processor provided with
20 a system where the gaps in the image are compensated through an exclusive operation so as to obtain a full image. However, not only is such an image processor expensive, but in many cases, it is difficult to detect the gap included in the image. Hence the conventional
25 image processor system is insufficient to eliminate the defect.

SUMMARY OF THE INVENTION

This Sheet Has Been Replaced



An object of the present invention is to provide a light source device where light projected on an object such as a solder leveler are reflected to an ITV camera without regard to inclinations of the surface of the object or existence of pinholes, thereby enabling to accurately detect the object.

Another object is to provide a light source device wherein the components of the emitted light substantially parallel to the surface of the object may be increased, thereby to prevent the picture image from darkening.

According to the present invention, there is provided a light source device for an image processor having a television camera comprising a light source disposed below the television camera, a shelter member disposed above the light source so as to prevent light emitted from the light source from directly entering the television camera, a cylindrical light transmitting barrel extending from the television camera to a position adjacent an object to be detected, and a diffusing plate having an opening at a central portion thereof and secured to an inside wall of the light transmitting barrel at a portion below the light source for diffusing the light emitted from the light source.

The inside wall of the light transmitting barrel has a pear-skin surface for causing diffused reflection of the light emitted from the light source.

An auxiliary light source such as an



electroluminescence may be provided at a lower portion in the light transmitting barrel.

A light transmitting member such as an optical fiber may be provided in the light transmitting barrel for transmitting the light of the light source to a lower end portion of the light transmitting barrel.

In accordance with the light source device of the present invention, the light transmitting barrel from which light is emitted is sufficiently extended to face the object, thereby widely diffusing the light from the entire caliber of the light transmitting barrel. Hence most of the reflected light enters the ITV camera despite the large inclination of the surface of the object or the existence of the pinholes. Moreover, the quantity of light falling on the object is increased, thereby enabling to use a light source emitting a relatively small quantity of light.

In addition, when a surface light source or an additional light source is added, the components of light which are substantially parallel to the surface of the object can be increased. Hence the quantity of light reflected on the object is increased, thereby preventing the picture image from becoming dark even if the inclination of the surface is large, or when there is a pinhole, thus enabling the image processor to recognize a complete image.

These and other objects and features of the present invention will become more apparent from the following

This Sheet Has Been Replaced



detailed description with reference to the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a sectional view of a conventional light
5 source device for an image processor;

Fig. 2 is a fragmentary sectional view of a light
source device for the image processor according to the
present invention;

Fig. 3 is a sectional view showing light sources
10 provided in the light source device of Fig. 2;

Fig. 4 is an illustration describing relations
between emitted light beams and the reflections thereof;
and

Figs. 5 to 8 are sectional views of various
15 embodiments of the light source device according to the
present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 2 shows a light source device according to the
present invention. The same references as those in Fig.
20 1 designate the same parts in Fig. 2.

The robot 1 is adapted to move the ITV camera 2 of
the image processor in the X and Y directions of the
print circuit board 3. A screw thread 4a is formed on
an inside wall of a lower portion of the lens barrel 4,
25 and a light source device 5 of the present invention is
attached to the lens barrel 4 by means of the screw



thread 4a.

The light source device 5 comprises a light transmitting barrel 6 screwed in the screw thread 4a of the lens barrel 4, a plurality of LEDs 7 as a light source annularly arranged in the light transmitting barrel 6 at a portion adjacent the upper edge of the light transmitting barrel 6. A shelter plate 8 having light transmitting opening 8a is secured to the inside wall of the light transmitting barrel 6 at a portion above the LEDs 7. A diffusing plate 9 having a light transmitting opening 9a is provided under the LEDs 7. An inner wall 6a of the light transmitting barrel 6 has a pear-skin (rough surface) reflector surface for causing diffused reflection.

The radially disposed LEDs 7 are connected with one another as shown in Fig. 3 and are controlled by a controller (not shown) so as to be lighted. The shelter plate 8 prevents the light of the LEDs from directly entering the ITV camera 2, thereby preventing causing noises in the image processor. As long as the upper portions of LEDs are covered, the shelter plate 8 may be formed into various shapes other than the planar shape shown in the figure. For example, the shelter plate 8 may be a reflector plate enclosing an upper side of each LED except for a lower portion thereof.

The light transmitting openings 8a and 9a are formed in the center portions of the shelter plate 8 and the diffusing plate 9, respectively, so that light



reflected on the standard mark 10 formed on the print circuit board 3 may reach the ITV camera 2. A transparent glass or a lens may be provided in the light transmitting openings.

5 The lower end of the light transmitting barrel 6 is located at a position which is very close to the standard mark as an object. For example, the distance between the end of the barrel 6 and the standard mark 10 is 2 mm to 5 mm.

10 In operation, the light emitted from the LEDs 7 is diffused by the diffusing plate 9. The diffused light is further reflected at random on the inner surface of the light transmitting barrel 6 which is formed into the pear-skin reflector surface. The diffused light is thus
15 directly projected on the standard mark 10 on the print circuit board 3. Hence the light applied on the standard mark 10 is diffused light projected from the entire caliber of the opening of the light transmitting barrel 6 which is considerably closely situated to the
20 object to be detected.

 Since the lower end of the light transmitting barrel 6 is close to the object, the range between the incident angles becomes wide as shown by a reference 11c in Fig. 4. The range corresponds to a hatched area
25 which is shown as the range of light applied to the point B in Fig. 4. As the illustration shows, even at the point B of the solder leveler 12 where the inclination is large, a reflected light Bo falls in a



range directed toward the ITV camera 2 including the incident light B_i . As a result, the solder leveler 12 is depicted as a complete image by a binary numeral, so that the position of the standard mark 10 is accurately
5 detected.

Even in the light device 5 as the first embodiment of the present invention, there may remain a small undetected portion along the periphery of the solder leveler 12 of Fig. 4. Namely, the light reflected on
10 the periphery is not directed to the ITV camera 2. Such a portion is very small and only formed evenly along the periphery of the solder leveler, so that the undetected portion can generally be neglected as a position detecting error. If it is undesirable to neglect the
15 error, the upper surface of the solder leveler is ground with abrasive such as sand paper to form a coarse surface, thereby causing a diffused reflection of the light. Thus, areas of the surface, the reflection therefrom is not directed to the ITV camera 2, are
20 diminished.

In a conventional system, polishing of the surface has already been carried out to form a smoother surface, hence decreasing the portion which does not reflect light aimed toward the ITV camera 2. However, in the
25 present invention, there is no need to further smooth the surface so that only a rough grinding is sufficient.

The light emitted from the light source, is lead through the light transmitting barrel 6, the lower





opening of which is positioned adjacent the object, so that the quantity of light diffused outside decreases. Therefore, a light source emitting a relatively small quantity of light suffices. Thus, instead of the
5 expensive cold-cathode tube, which emits a large quantity of light, inexpensive LEDs can be used.

In order to increase the incident angle of the light falling on the object, it is preferable to increase the caliber of the lower opening of the light
10 transmitting barrel 6 as much as possible. On the other hand, in order to decrease the quantity of light diffusing outside, the opening is made as small as possible. It is hence necessary to determine the caliber of the barrel 6 in consideration to these
15 inconsistent problems.

In the light source device 5 of the first embodiment, the quantity of components of light substantially parallel to the surface of the object is smaller than the components of light substantially
20 perpendicular to the surface. In other words, when the inclination of the surface of the solder leveler is large, or pinholes are formed in the solder leveler, the picture image becomes dark, so that gaps may be formed in the two-value data for the detected image. The
25 second to fifth embodiments shown in Figs. 5 to 8, respectively, are intended to increase the components which are substantially parallel to the surface of the object. In each of the figures, the same references as



those in Fig. 2 designate the same parts so that the descriptions thereof are omitted.

Referring Fig. 5, the light source device 5 of the second embodiment of the present invention is provided with a cylindrical surface light source 13 in addition to the light source of LEDs 7. The surface light source 13 comprises an electroluminescence, fixed to the inner wall 6a of the light transmitting barrel 6 at a lower portion thereof. The inner wall of the surface light source 13 has a pear-skin surface to cause the diffused reflection of light. The surface light source 13 is applied with electric current and has a capacity for emitting a predetermined quantity of light.

The surface light source 13 emits light from the entire surface thereof. The emitted light is substantially parallel to the surface of the standard mark 10. Thus the horizontal components of light are increased so that sufficient quantity of light is transmitted to the ITV camera even if the surface of the solder leveler 12 is largely inclined, or pinholes are formed. Hence, no gaps are formed in the binary numerals for the detected image.

In the third embodiment shown in Fig. 6, a light transmitting member 15 comprising a cylindrical acrylic resin plate is attached to the inner surface of a lower portion of the light transmitting barrel 6. The inner surface of the light transmitting member 15 has a pear-skin surface so as to cause diffused reflection. The



light transmitting member 15 has a light emitting
portion 15a which flares out downwardly. The light
emitted from the LEDs 7 passes through the light
transmitting member 15 and is radiated from the light
5 emitting portion 15a toward the standard mark 10.

Referring to Fig. 7, showing the fourth embodiment
of the present invention, a plurality of optical fibers
16 are annularly disposed between the LEDs 7 and a lower
end of the light transmitting barrel 6. The upper end
10 of each optical fiber 16 is disposed adjacent the LEDs
7. An intermediate portion of the optical fiber is
extended outside the barrel 6. The lower end re-enters
the barrel 6 so as to face the lower end to the inner
space of the barrel, thereby emitting a light in the
15 horizontal direction. The inner wall 6a of the light
transmitting barrel 6 has a pear-skin surface. Thus,
the third and fourth embodiments provide the same effect
as that of the second embodiment shown in Fig. 5.

Referring to Fig. 8, the fifth embodiment of the
20 present invention has a cylindrical surface light source
member 17 comprising an electroluminescence which covers
the entire inner surface of the light transmitting
barrel 6. The surface light source member 17 has an
annular plate 17a having a central opening 17c at the
25 upper inner portion thereof. A cylindrical body 17b of
the light source member 17 is fixed to the barrel 6 and
the annular plate 17a is fixed to a mounting plate 9b
attached to the inner wall of the light transmitting



barrel 6. LEDs are not provided in this embodiment.

Since an electroluminescence having a large capacity is used as the light source 17, the same effect as those of the previous embodiments is obtained
5 although the LEDs are omitted in the present embodiment.

Although the present invention has been described in conjuncture to the image processor converting the picture image into two-value data, the invention may arranged to produce an image data represented by
10 multiple values.

From the foregoing, it will be understood that the present invention provides a light source device for an image processor wherein the light projected to the object to be detected is diffused from lower opening of
15 the light transmitting barrel which is sufficiently close to the object. Accordingly, the light reflected on the object is substantially completely transmitted to the ITV camera despite the large inclinations and pinholes formed on the surface of the object.

20 The light emitted from the light source is lead through the light transmitting barrel without diffusing outside of the barrel, so that it is possible to use an inexpensive light source capable of emitting a small quantity of light. Moreover, the components of light
25 which are substantially parallel to the surface of the object are increased, so that gaps in the detected image data are diminished.

While the invention has been described in



conjunction with preferred specific embodiment thereof,
it will be understood that this description is intended
to illustrate and not limit the scope of the invention,
which is defined by the following claims.

5



What is claimed is

1. A light source device for an image processor having a television camera, comprising:

5 a light source disposed below the television camera;

a shelter member disposed above the light source so as to prevent light emitted from the light source from directly entering the television camera;

10 a cylindrical light transmitting barrel extending from the television camera to a position adjacent an object to be detected; and

15 a diffusing plate having an opening at a central portion thereof and secured to an inside wall of the light transmitting barrel at a portion below the light source for diffusing the light emitted from the light source.

2. The light source device according to claim 1 wherein

20 an inside wall of the light transmitting barrel has a pear-skin surface for causing diffused reflection of the light emitted from the light source.

3. The light source device according to claim 1 wherein

25 a lower end of the light transmitting barrel is disposed at a position of 2 mm to 10 mm from the object.

4. The light source device according to claim 1 further comprising

an auxiliary light source provided at a lower





portion in the light transmitting barrel.

5. The light source device according to claim 1 further comprising

5 a light transmitting member provided in the light transmitting barrel for transmitting the light of the light source to a lower end portion of the light transmitting barrel.

6. The light source device according to claim 4 wherein

10 the auxiliary light source is a surface light source.

7. The light source device according to claim 5 wherein

15 the light transmitting member is a cylindrical acrylic resin plate.

8. The light source device according to claim 5 wherein

the light transmitting member is a plurality of optical fibers.

20 9. The light source device according to claim 6 wherein

the surface light source is an electroluminescence.

10. A light source device for an image processor having a television camera, comprising:

25 a cylindrical light transmitting barrel extending from the television camera to a position adjacent an object to be detected;

a surface light source provided in the light





* C L M S *

transmitting barrel; and

a shelter member disposed above the surface light source so as to prevent light emitted from the light source from directly entering the television camera.

5 11. The light source device according to claim 10 wherein

the surface light source is an electroluminescence.

10

This Sheet Has Been Replaced

